CAUSES OF UNDERGROUND STORAGE TANK LEAKS AND RECOMMENDATIONS

REPORT TO THE SENATE COMMITTEE ON NATURAL RESOURCES AND ENVIRONMENTAL AFFAIRS

AND

THE HOUSE COMMITTEE ON CONSERVATION, ENVIRONMENT AND GREAT LAKES AFFAIRS

JULY, 1995

DNR

UNDERGROUND STORAGE TANK DIVISION

INTRODUCTION

This report was prepared to fulfill the requirements in the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), Part 211 Underground Storage Tank Regulations. Specifically, Section 21108(8) of Act 451 states that:

> *"The department shall conduct a study regarding the causes of underground storage tank leaks and prepare a report making recommendations regarding upgrading underground storage tank system standards, establishing timetables for the replacement of the equipment, and instituting any other practices or procedures which will minimize releases of regulated substances into the environment. The report shall be submitted by July 1, 1995 to the members of the legislature who are members of committees dealing with the natural resource issues."*

This report is based on the data that was recorded by the Hazardous Materials Storage Inspectors (HMSIs) of the Underground Storage Tank Division during their inspections of leaking underground storage tank (LUST) sites and during inspections of the removal of underground storage tanks (USTs). The data for this study was obtained from May 1994 to March 1995. Data collection was done for the following items:

- Source of Release
- Substance released
- Tank construction
- Tank design
- Corrosion protection method for tanks
- Corrosion protection methods for piping
- Size of tank
- Age of tank
- Piping design
- Piping construction

The above list provides sufficient information for analyzing the factors that may contribute to tank releases. Based on this study, recommendations regarding upgrading of USTs, timetables for replacement of equipment, and instituting other practices or procedures which will minimize releases of regulated substances to the environment are contained in this report.

STUDY INFORMATION

During the study, the materials of construction, corrosion protection methods, and system design were checked for the following sub-categories:

MATERIALS OF CONSTRUCTION

steel tank	constructed entirely of steel - may be single or double walled
FRP tank	constructed entirely of 'fiberglass reinforced plastic' - may be single or double walled
concrete tank	constructed of concrete and reinforcing steel bars - mostly single walled
steel pipe	constructed entirely of steel - may be single or double walled
FRP pipe	constructed entirely of 'fiberglass reinforced plastic' - may be single or double walled

CORROSION PROTECTION

FRP tank	constructed entirely of 'fiberglass reinforced plastic' - does not corrode
cathodically protected steel tank	steel tank with dielectric coating and sacrificial anodes attached to the tank by manufacturer
impressed current	cathodic protection installed at the site (not attached to the tank)
steel clad tank	steel tank with FRP coating (minimum 100 mil coating)
steel jacketed tank	steel tank with nonmetallic layer covering an interstitial space (minimum 100 mil coating)
FRP pipe	constructed entirely of 'fiberglass reinforced plastic' - does not corrode
steel (factory coated) pipe	dielectric coating - only corrosion protection when used in conjunction with anodes
steel (galvanized) pipe	galvanized steel - only corrosion protection when used in conjunction with anodes
polyethylene pipe	constructed entirely of polyethylene - does not corrode
anode	usually made of zinc or magnesium and will protect steel by creating a voltage difference between the metals, causing cathodic protection current flow onto the steel
bare steel	no corrosion protection

SYSTEM DESIGN

single wall tank	no secondary containment
double wall tank	two walled tank - provides interstitial space between walls - secondary containment
steel (jacketed) tank	provides interstitial space between steel and nonmetallic jacket - secondary containment
single wall pipe	no secondary containment
double wall pipe	two walled pipe - provides interstitial space between walls - secondary containment
flexible pipe	polyethylene pipe - may be single or double wall

STUDY RESULTS

For the systems surveyed the breakdown by sub-category is given below. Figures 1 through 10 provide this information in bar chart form. Figures 11 through 20 give this information in pie chart form.

SOURCE OF RELEASE
Piping..... 280
Dispenser 140
Tank..... 247
Spill /Overfill 307
Unknown 236

SUBSTANCE RELEASED
Gas..... 579
Diesel 179
Used Oil..... 70
Other..... 106

TANK CONSTRUCTION
Steel..... 930
Fiberglass 50
Concrete..... 7
Other..... 14

TANK DESIGN
Single Wall..... 968
Double Wall 3
Steel Jacketed..... 3
Other..... 2

CORROSION PROTECTION TANKS
Fiberglass 55
Protected Steel 62
Clad 18
Jacketed 1
Impressed Current 0
None 787
Other..... 32

SIZE OF TANK
0 - 1,100..... 279
1,101 - 4,000..... 264
4,001 - 10,000..... 324
10,001 - 50,000..... 76
Size Unknown 35

AGE OF TANK
0 - 1..... 2
2 - 5..... 14
6 - 10..... 73
11 - 15..... 76
16 - 20..... 148
21 & Over 248
Unknown..... 307

PIPING DESIGN
Single Wall 926
Double Wall..... 19
Flexible..... 0
Other..... 3

PIPING CONSTRUCTION
Steel 917
Fiberglass 39
Other..... 5

CORROSION PROTECTION PIPING
Fiberglass 40
Coated..... 24
Galvanized..... 193
Polyethylene 0
Anode..... 0
Bare Steel..... 111
None 572
Other..... 18

Note: Totals may not be equal due to insufficient information available during the time of the study.

CONCLUSIONS

The study clearly documents the obvious factor that bare (no corrosion protection) steel single wall tanks and piping are the most significant factor in releases. Over 83 percent of the UST releases were due to deteriorated bare steel single wall tanks, and 61 percent of the releases from UST piping resulted from bare steel piping.

No failures were discovered from tanks having impressed current corrosion protection. However, tanks with sacrificial anodes accounted for six percent of the releases. In addition, fiberglass-reinforced plastic (FRP) tanks accounted for six percent of the releases and FRP coated tanks another two percent of releases. This shows that despite measures to curtail corrosion, there will be some releases from these systems for other reasons.

There was no correlation between tank size and leakage. The study shows the releases to be distributed over the tank size range.

Tank age was a factor in the releases. Tanks over 21 years or unknown age accounted for 64 percent of the releases.

Releases from new tank systems are mainly due to improper installation or contractor error. Examples include failure of double walled fiberglass piping during the winter months, and contractors damaging piping systems when constructing forms for concrete to be poured above the piping.

The greatest single source of releases were spills at the fill pipe of the tank and overfilling the tank. Prior to the requirement of spill protection, transport drivers would often drain the residual product from the delivery hose into the soil surrounding the fill pipe.

SUMMARY OF UNDERGROUND STORAGE TANK RULES

The current Michigan Underground Storage Tank Rules provide the technical performance standards for new UST systems (installed after December 22, 1988) and the timetable to upgrade existing systems (see Figure 21). By December 22, 1998, all existing UST systems must be upgraded to comply with the performance standards for new UST systems. If the system is not upgraded it must be removed from the ground, or if under a structure, permanently closed-in-place. The main areas of tank/piping design and construction covered in the rules and the compliance deadline are summarized below:

- CORROSION PROTECTION: To prevent releases from corrosion, all new tanks are required to be fiberglass-reinforced plastic, FRP coated steel, steel jacketed with a nonmetallic material or cathodically protected steel. In addition, piping systems have to be FRP, enclosed in a nonmetallic material or cathodically protected steel. Existing tanks and piping have to upgraded by December 22, 1998.

- SPILL PROTECTION AND OVERFILL PREVENTION: To prevent releases due to spillage around the fill pipe during delivery or due to overfilling tanks, the rules require spill protection equipment and overfill shut-off valves or alarms. Spill protection equipment has been required on all existing tanks since January 1992. Overfill prevention equipment has to be installed on existing systems by December 22, 1998.

- SECONDARY CONTAINMENT: New UST systems are prohibited under certain circumstances and secondary containment is required where the UST system is in close proximity to drinking water wells and surface water intakes or where the UST system presents an unacceptable risk of contamination to surface water, wetlands, or an aquifer (see Figure 22).

- HOLIDAY TESTING: For FRP clad steel tanks, holiday testing to locate defects in the cladding is required to ensure system integrity.

- INSTALLATION CERTIFICATION: To demonstrate compliance with the UST system design requirements, certifications are required from the installer.

- ON-SITE INSPECTION: New tank installations are inspected by USTD inspectors prior to use.

- RELEASE DETECTION METHODS: Required on all new UST systems and this requirement for existing systems was phased in from December 1989 and now applies to all existing systems.

- OPERATION AND MAINTENANCE REQUIREMENTS: The rules require that the cathodic protection system be monitored on a set schedule and release detection be monitored every 30 days.

RECOMMENDATIONS

Based on the findings of the study, the Department of Natural Resources (DNR) submits the following recommendations:

1. The Michigan Underground Storage Tank Rules now require spill protection and release detection for all tank systems and require that existing tank systems be upgraded to provide corrosion protection and overfill prevention by December 22, 1998 or be closed (removed or closed-in-place). We recommend that the DNR continue to identify all existing UST systems that do not meet current requirements and take appropriate enforcement action when necessary. In addition, we will continue to inform owners/operators of UST systems of the mandatory requirement of upgrading existing tank systems or closure by the December 22, 1998 deadline.

2. Inasmuch that the vast majority of releases are due to failure of old, unprotected steel tanks and piping, and the rules require upgrading or closure by a specified deadline, we recommend that the current technical standards and compliance schedule for tank systems under the rules remain as is with the following addition:

   To afford greater protection to the state's drinking water supplies, require secondary containment in designated Wellhead Protection areas of the state.

   The DNR's Underground Storage Tank Division has convened an Ad Hoc Committee to revise the current UST Rules and the above recommendation has been discussed among members of the committee.

3. To minimize releases from newly installed UST systems, we recommend that the DNR continue its program of inspecting all new UST systems. The Ad Hoc Committee is considering a revision to the rules to require that installation of new piping systems (alone without a new tank) be required to be inspected.

   Part 211 also requires a person who installs or removes a tank system to carry $1 million pollution liability insurance. This coverage is required to pay for cleanup of a release caused by contractor error.

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FIGURE 1: CORROSION PROTECTION - TANKS

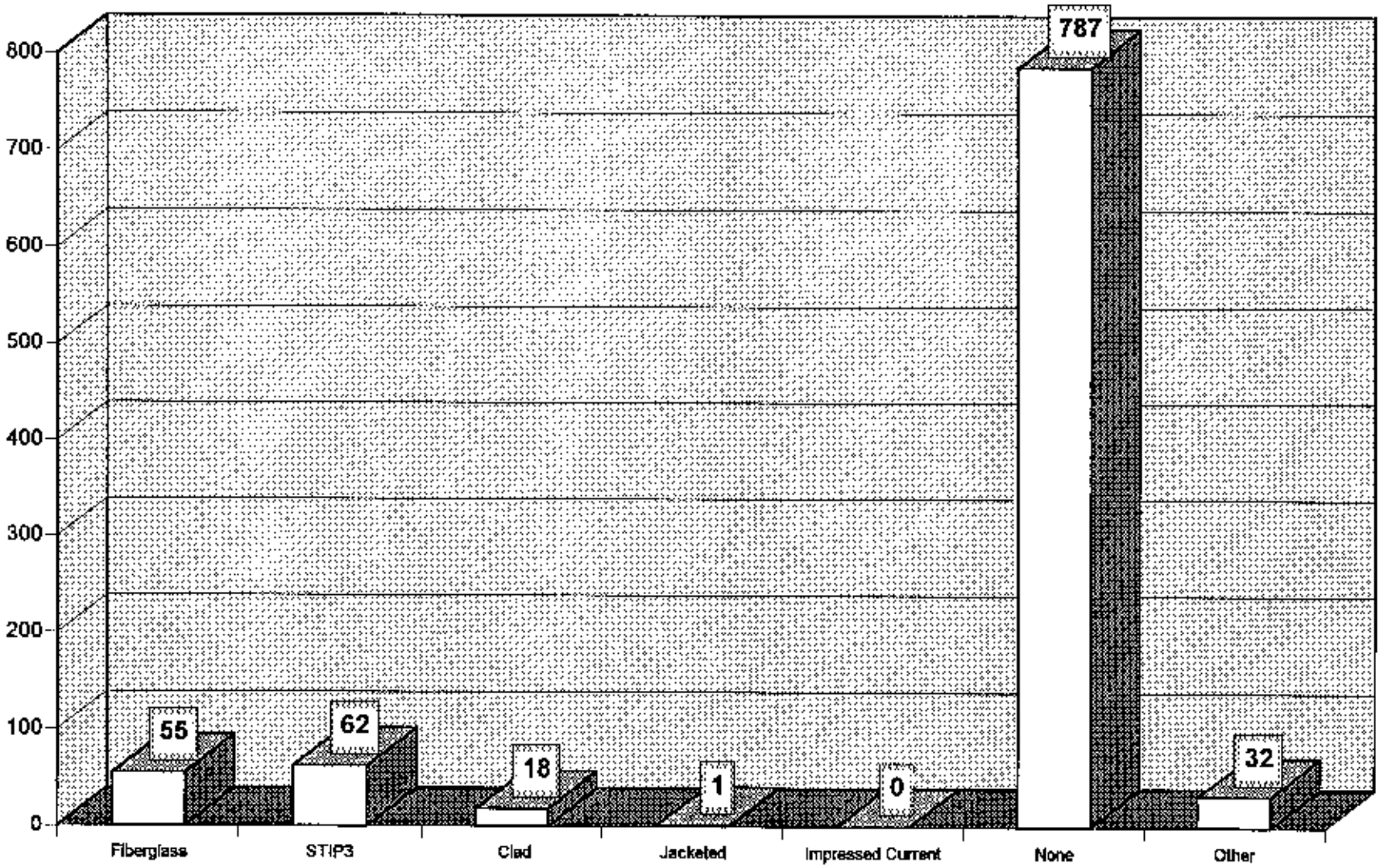

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FIGURE 2: CORROSION PROTECTION - PIPING

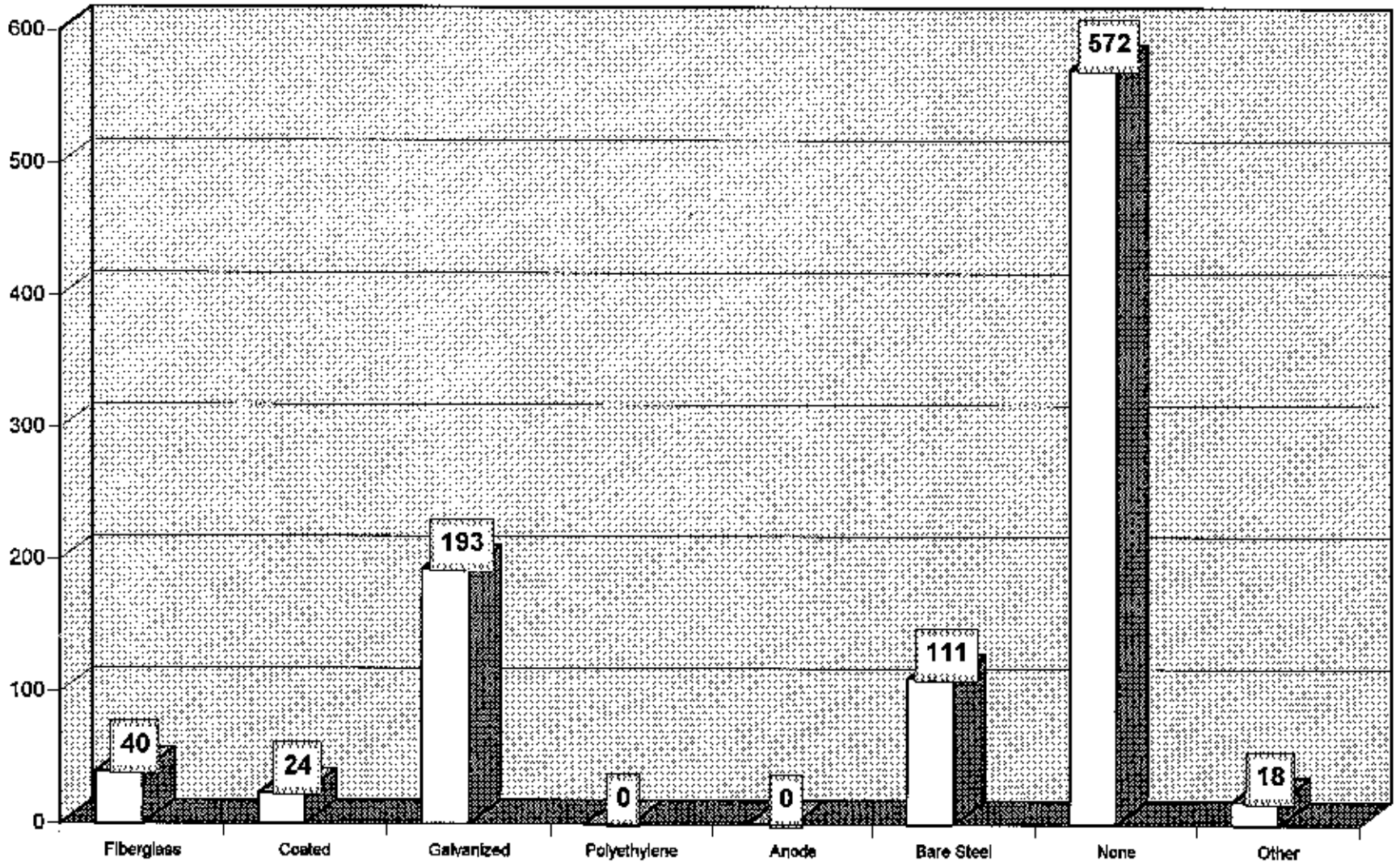

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FIGURE 3: SUBSTANCE STORED

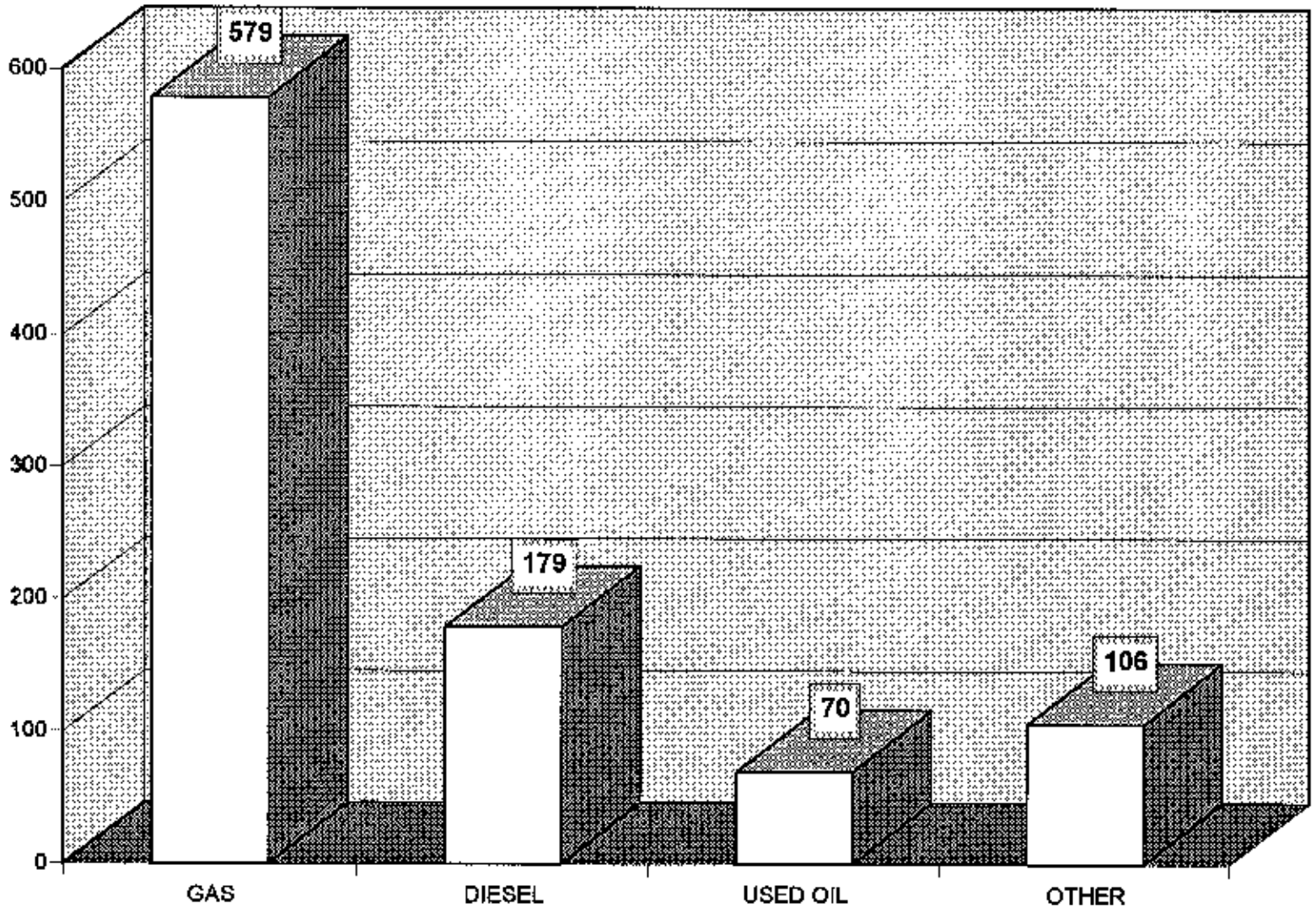

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FIGURE 4: SOURCE OF RELEASE

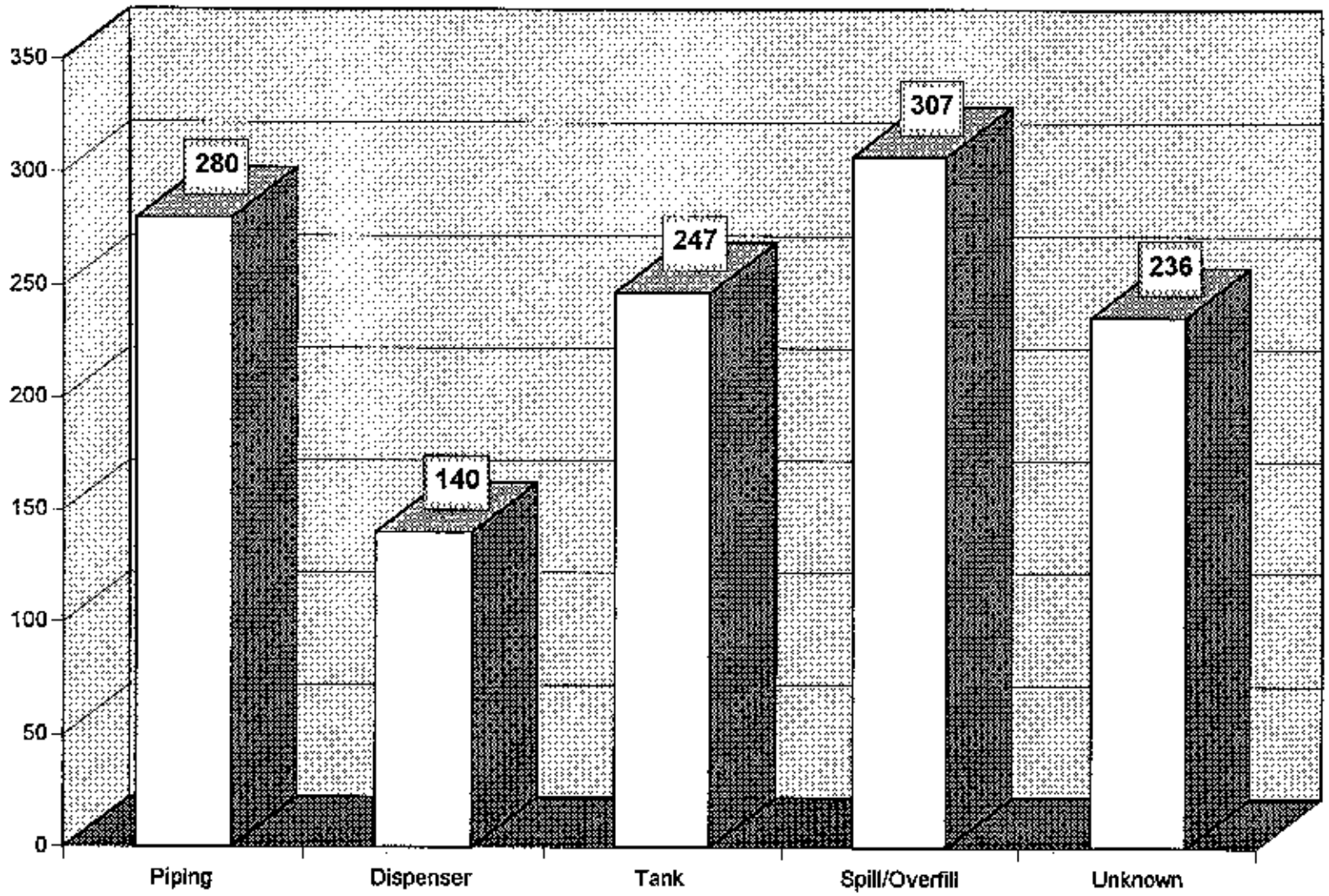

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FIGURE 5: TANK CONSTRUCTION

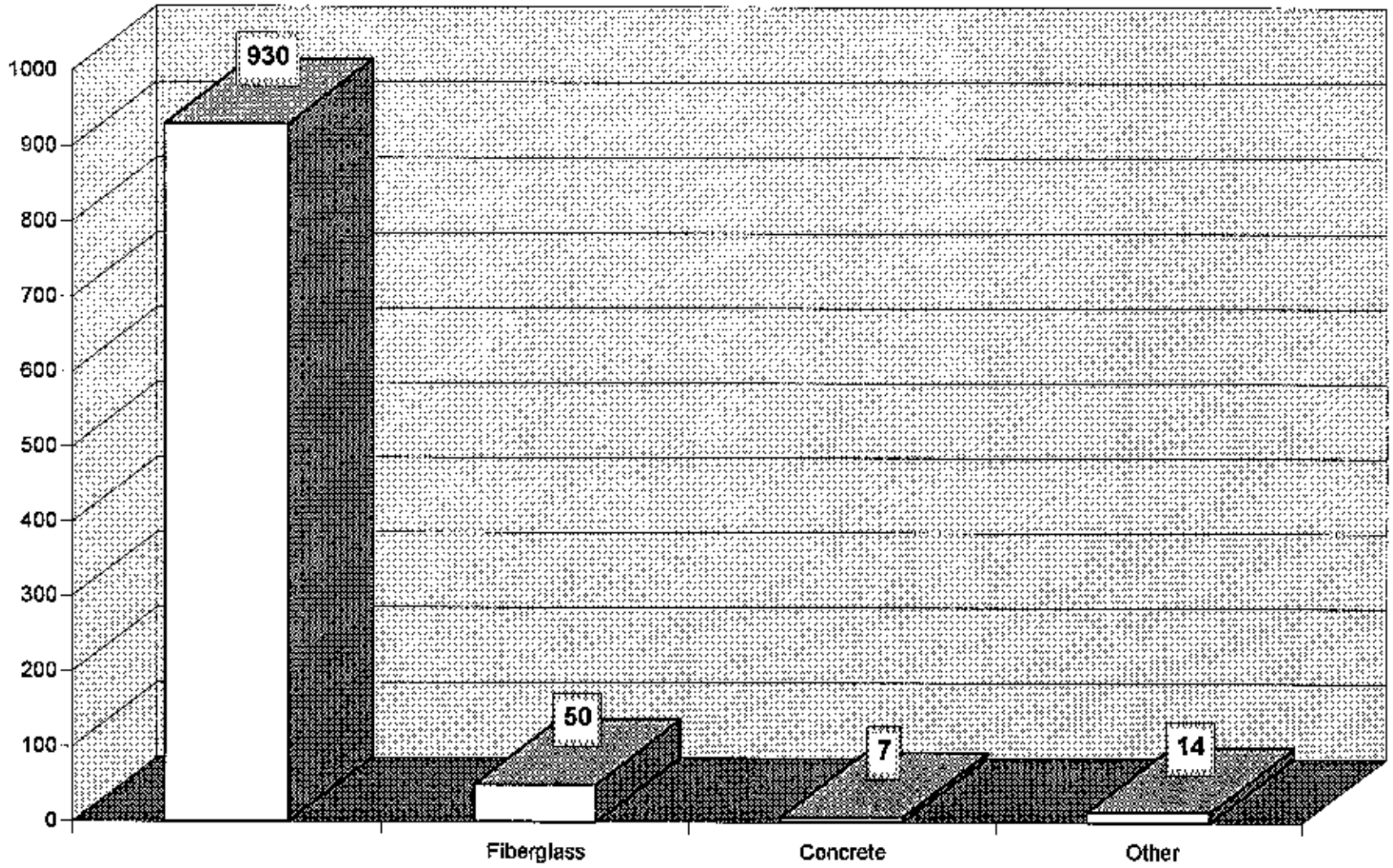

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FIGURE 6: TANK DESIGN

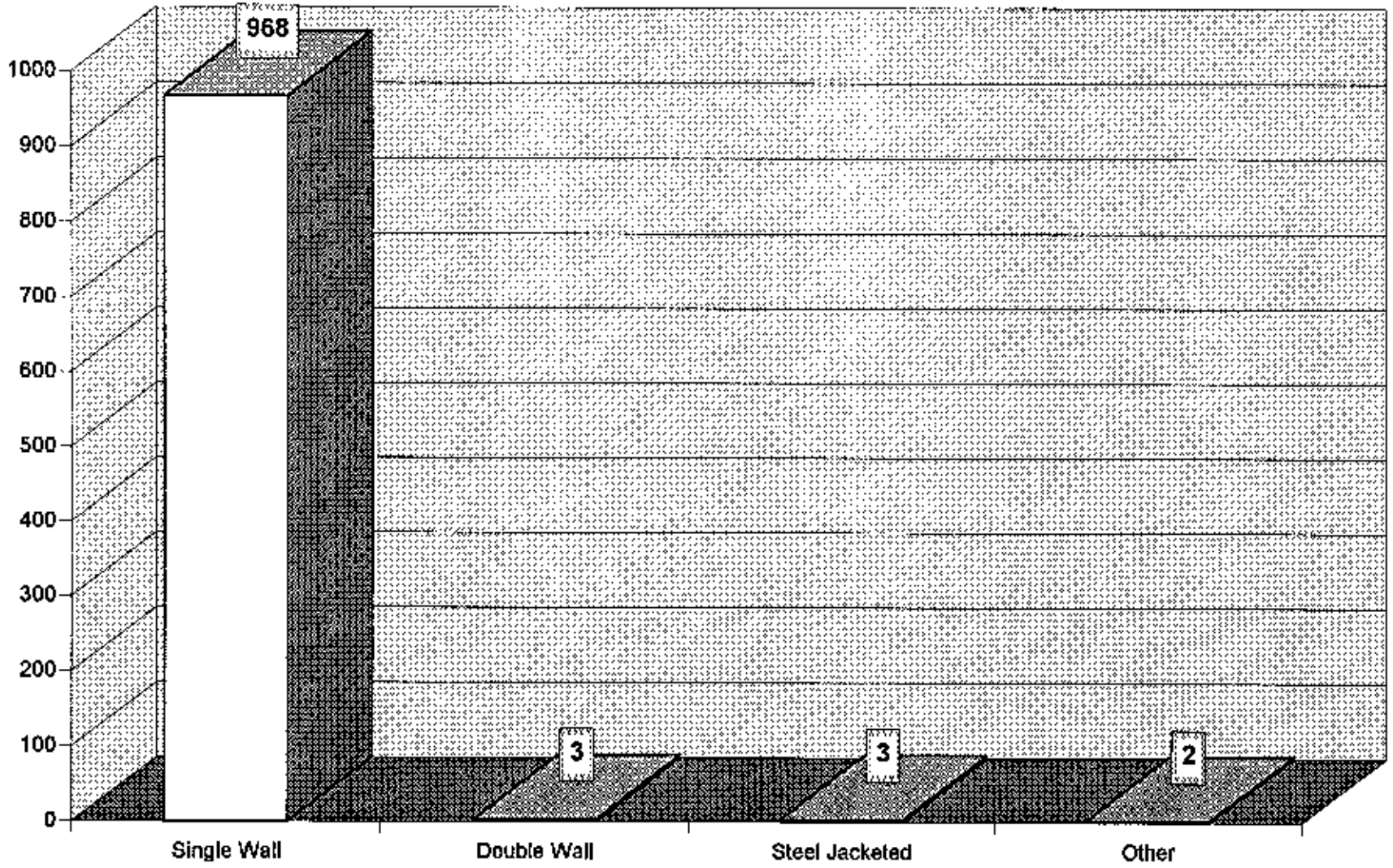

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FIGURE 7: SIZE OF TANK

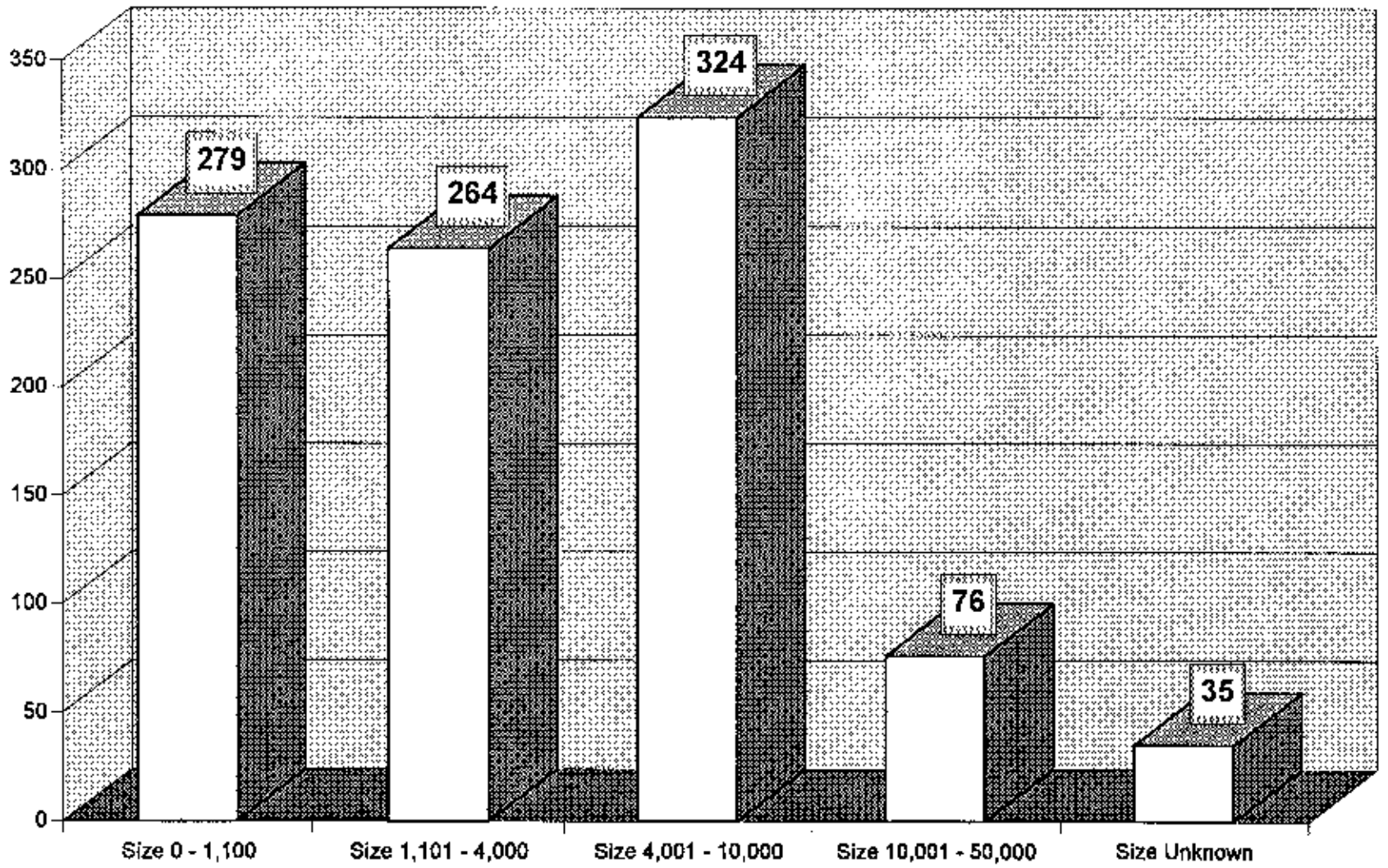

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FIGURE 8: AGE OF TANK

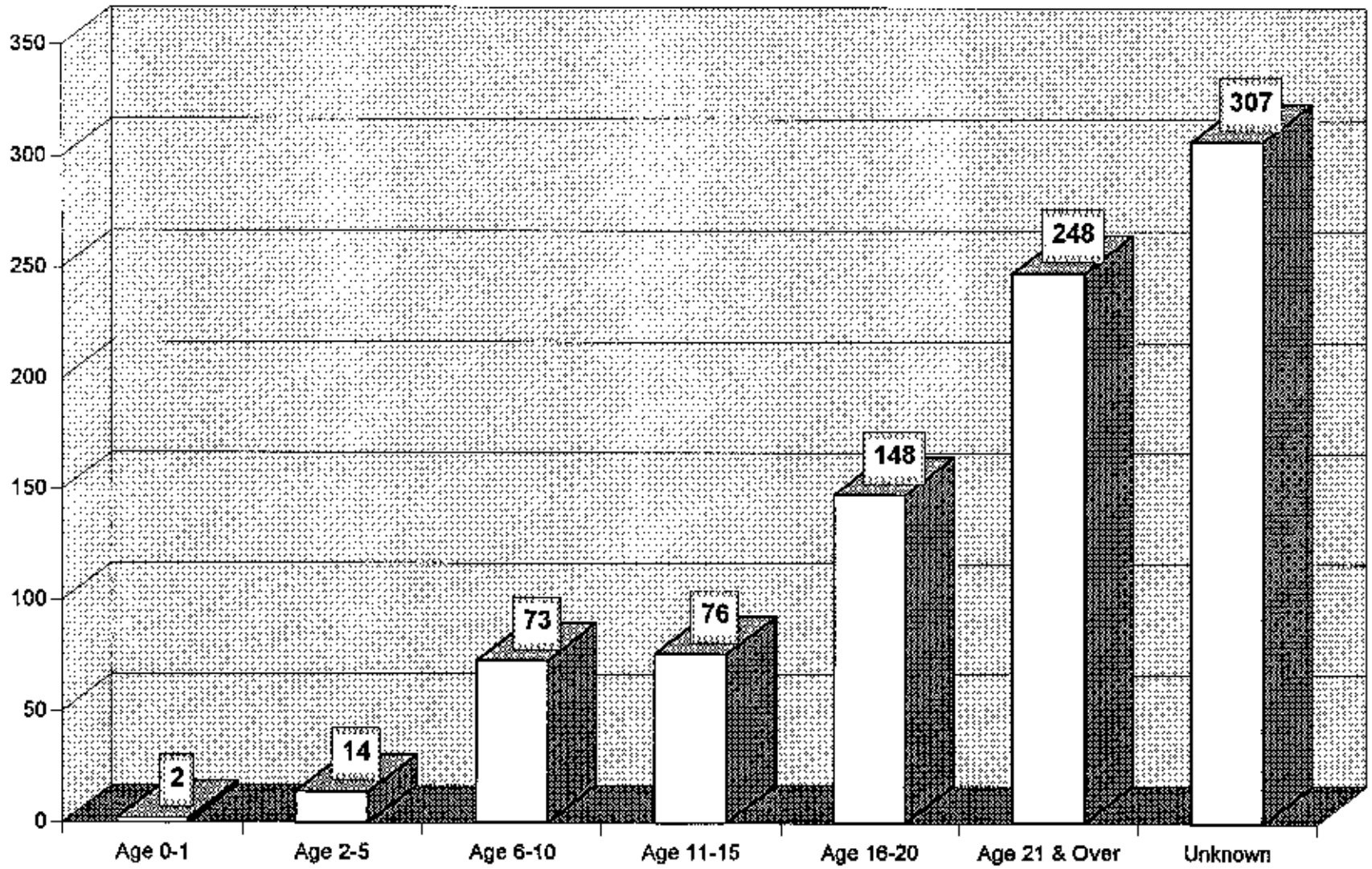

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FIGURE 9: PIPING DESIGN

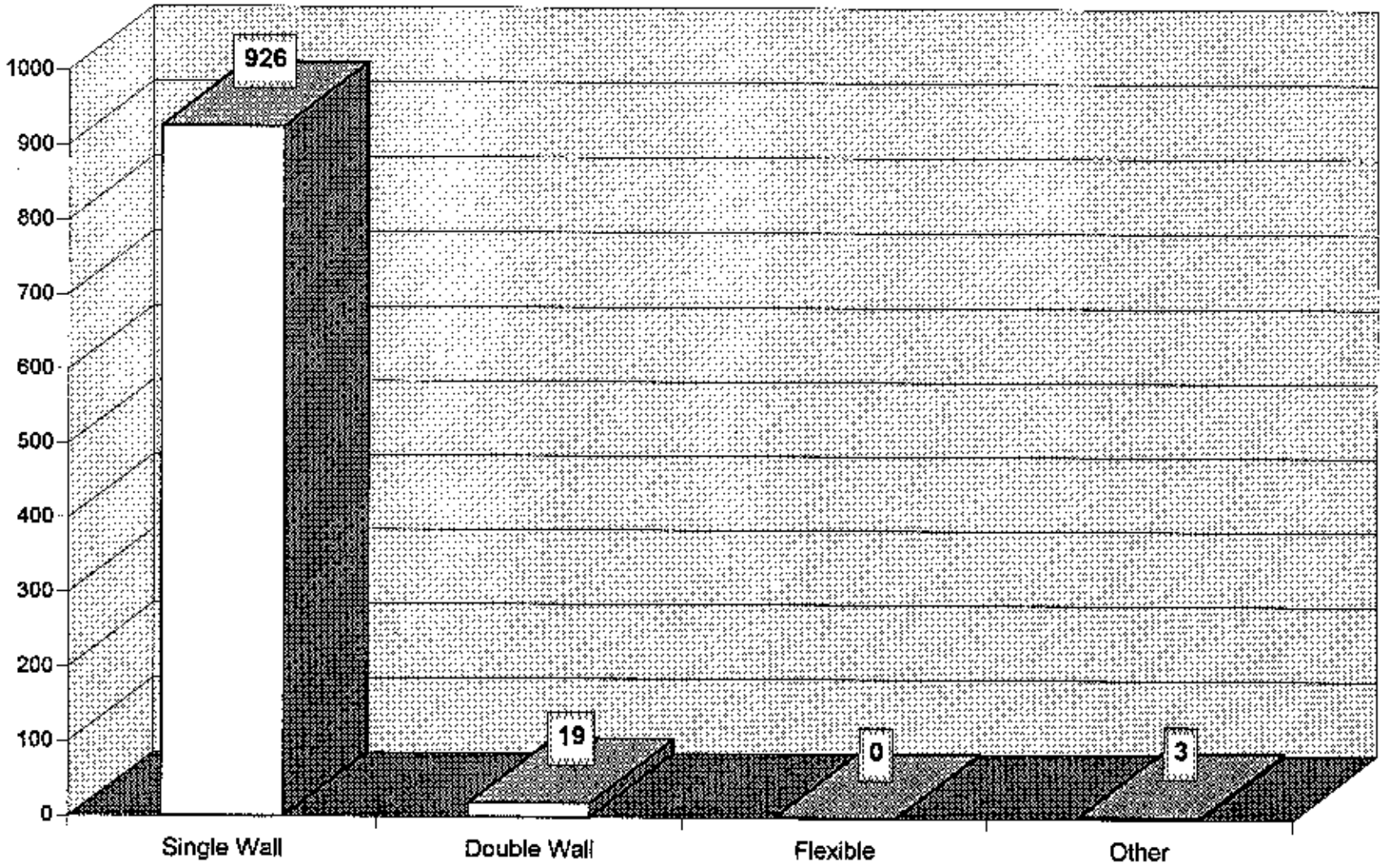

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FIGURE 10: PIPING CONSTRUCTION

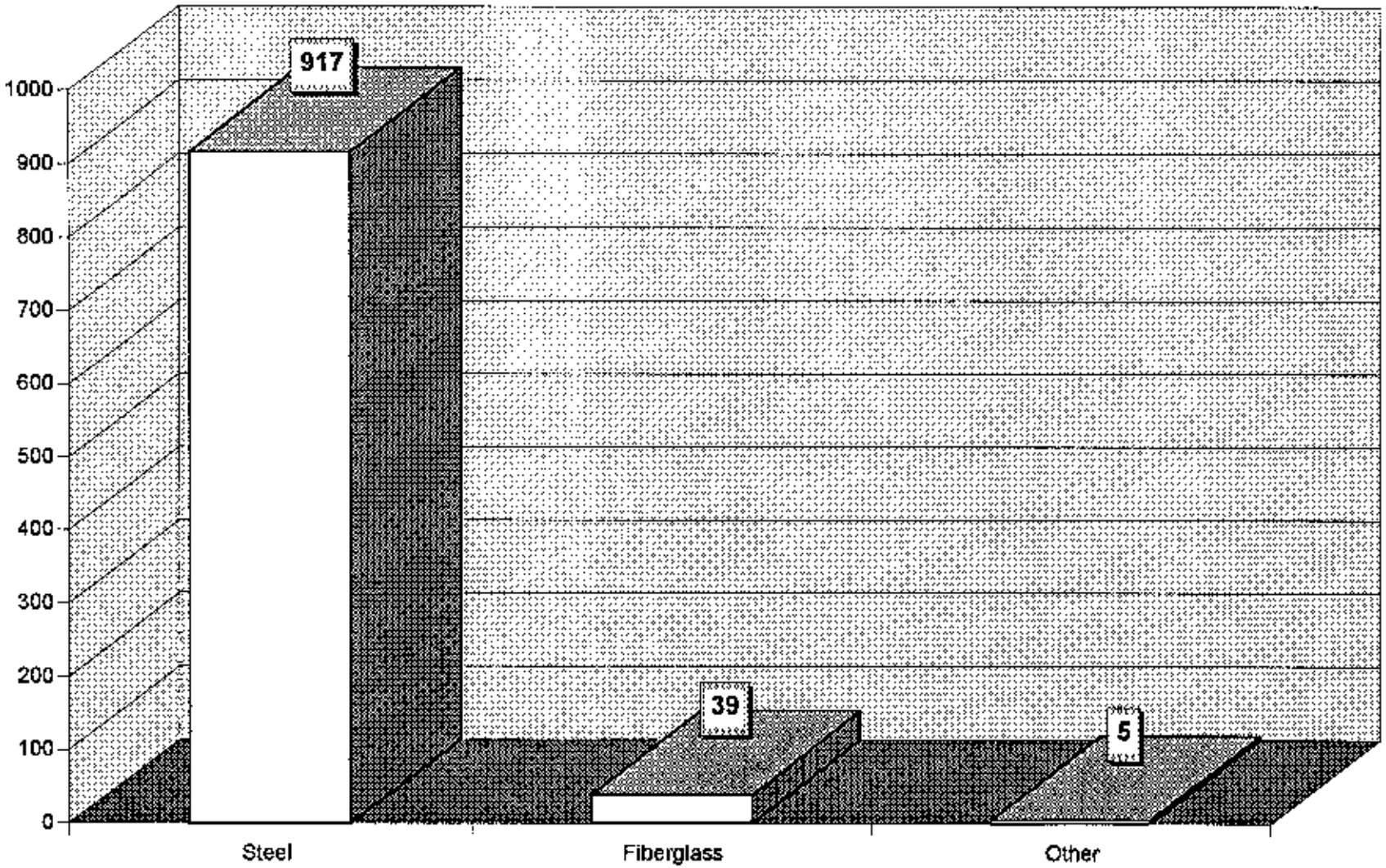

FIGURE 11: SOURCE OF RELEASE

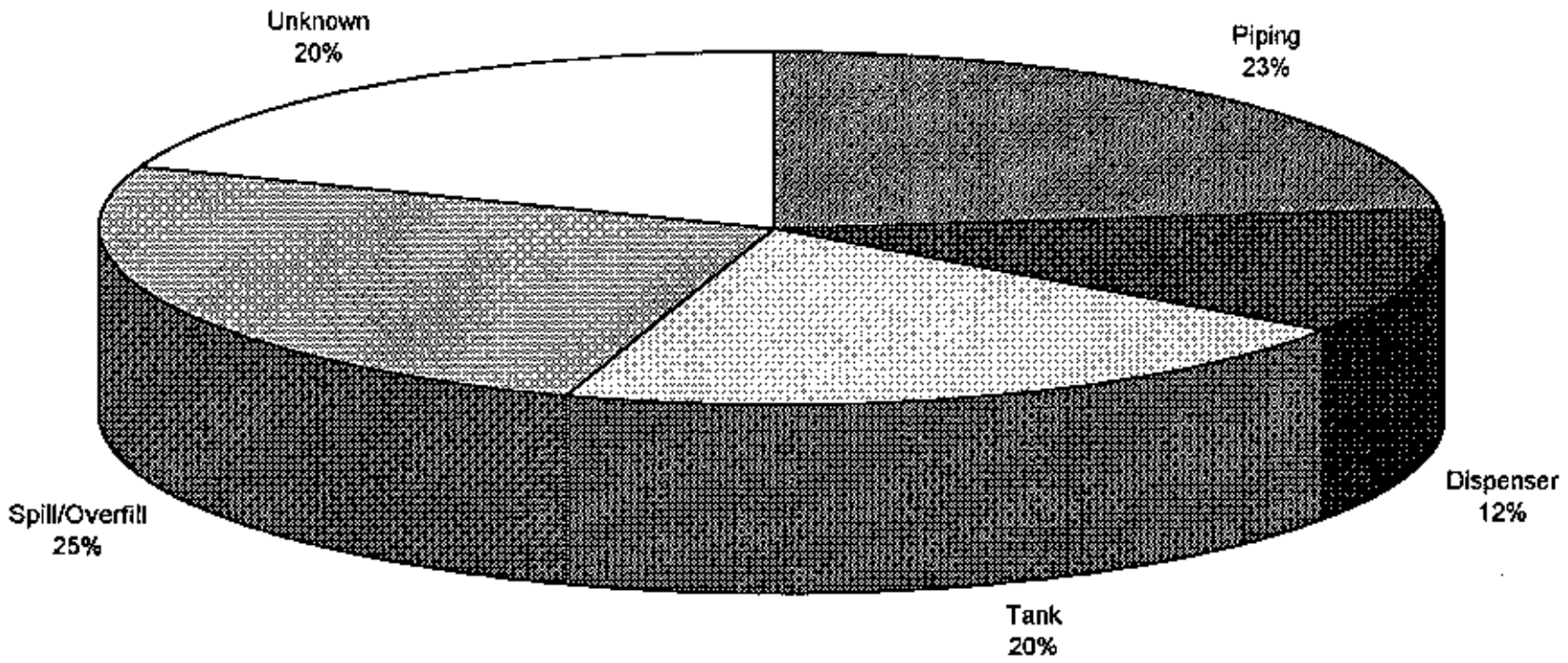

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FIGURE 12: SUBSTANCE

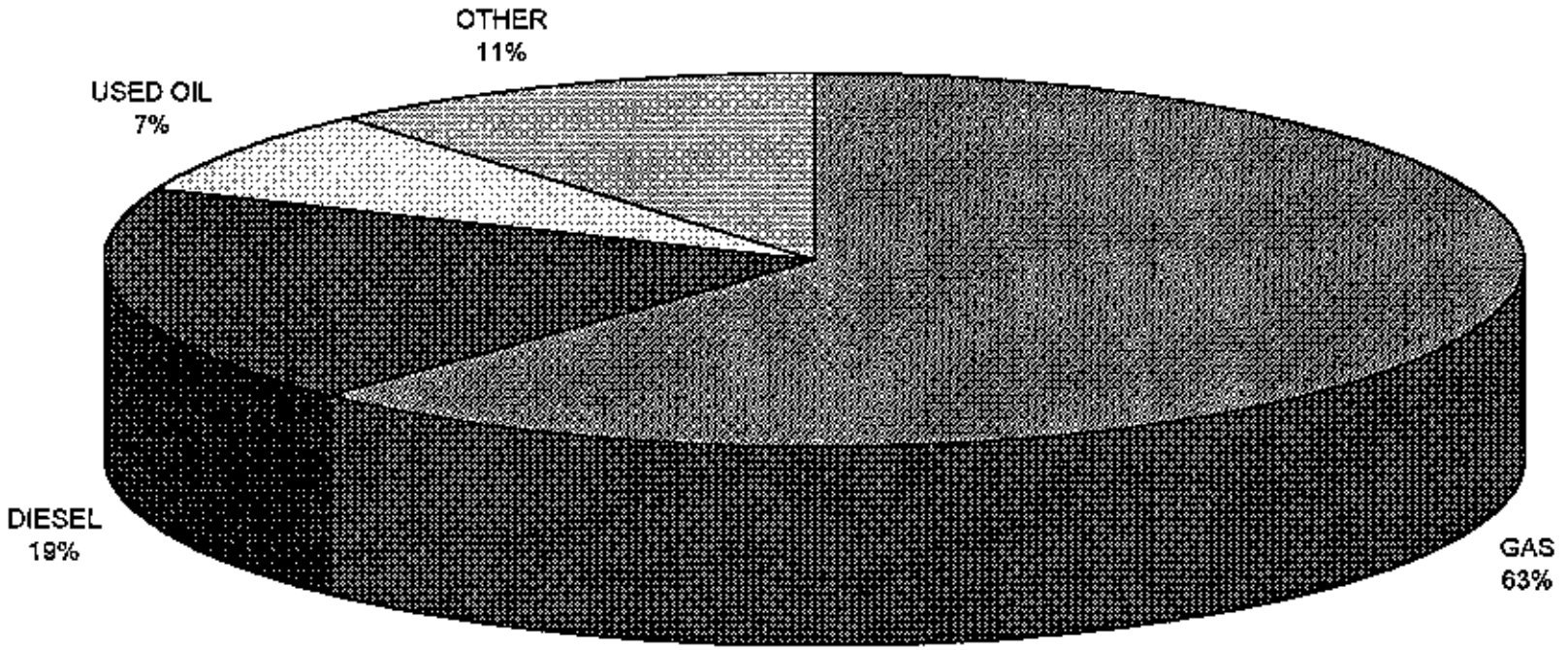

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FIGURE 13: TANK CONSTRUCTION

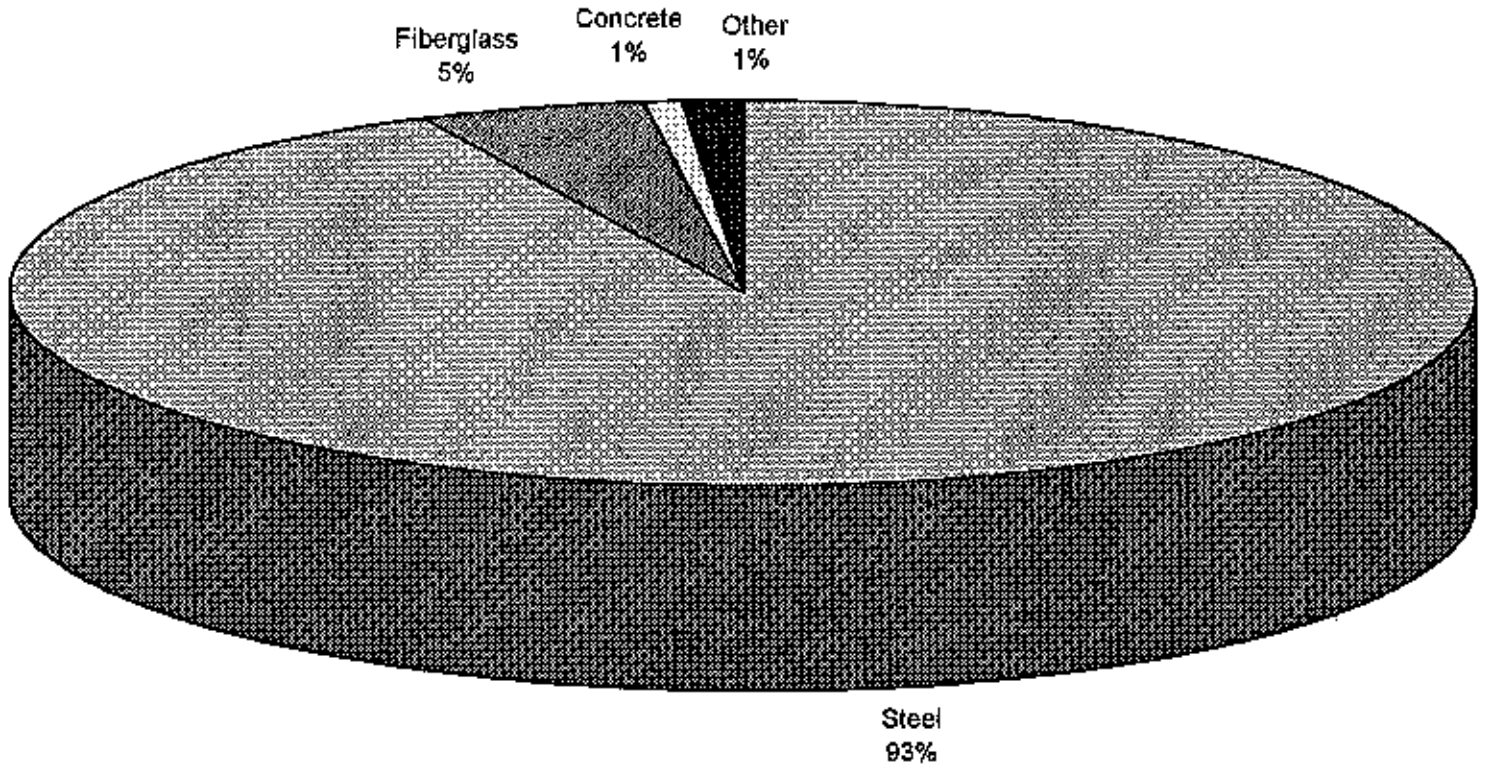

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FIGURE 14: TANK DESIGN

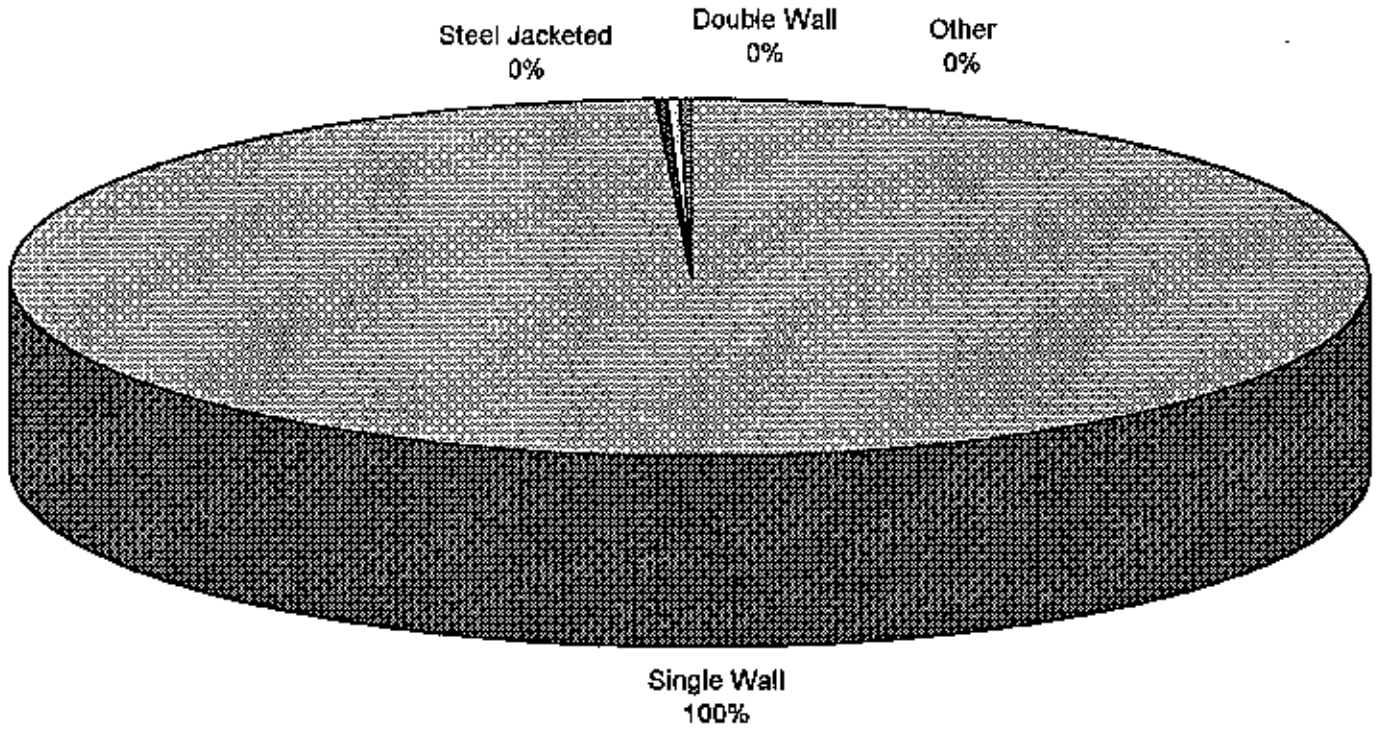

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FIGURE 15: CORROSION PROTECTION - TANKS

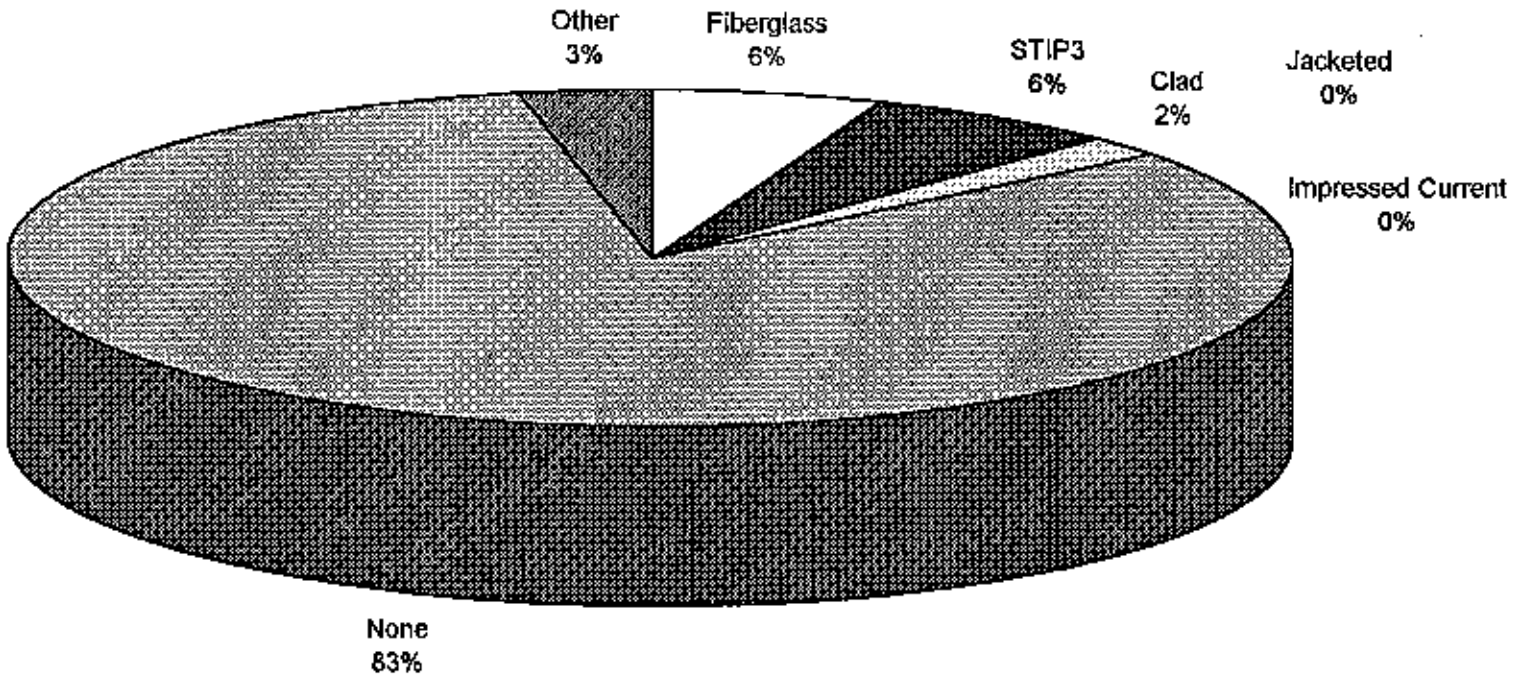

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FIGURE 16: SIZE OF TANK

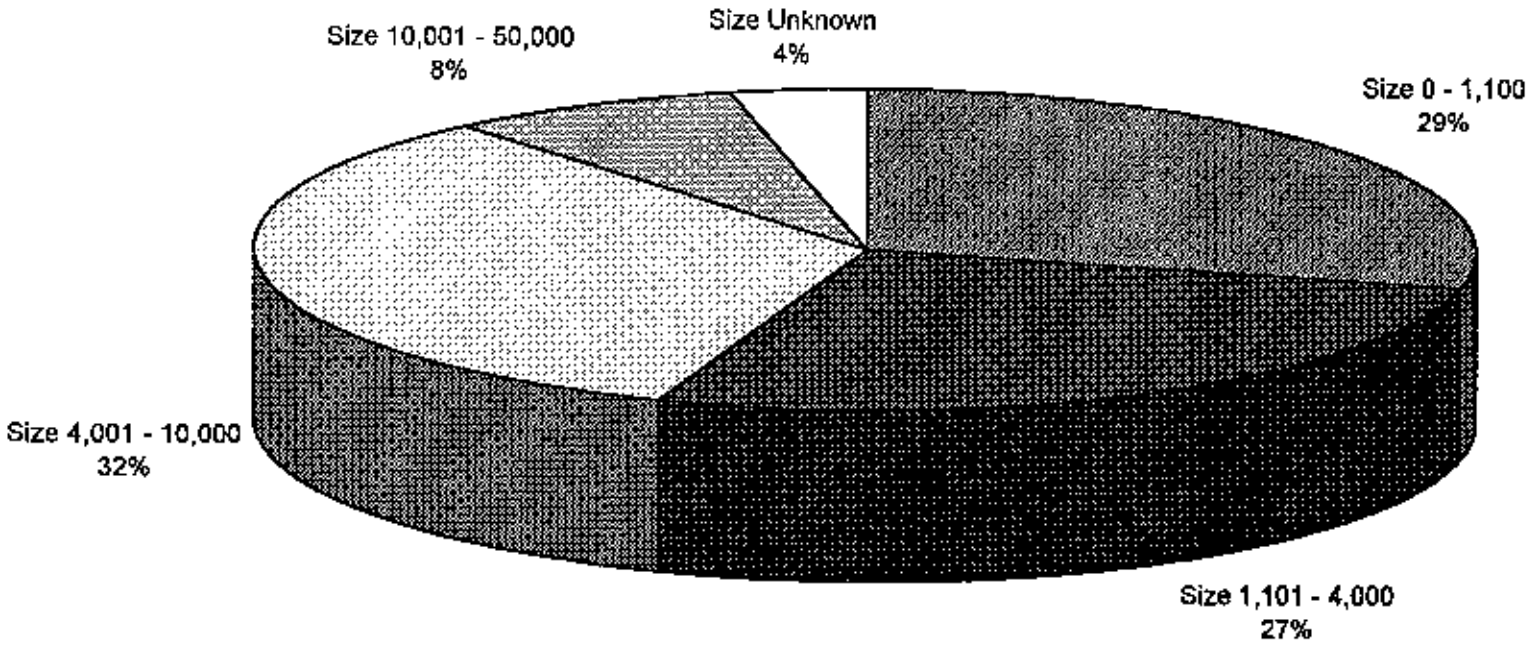

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FIGURE 17: AGE OF TANK

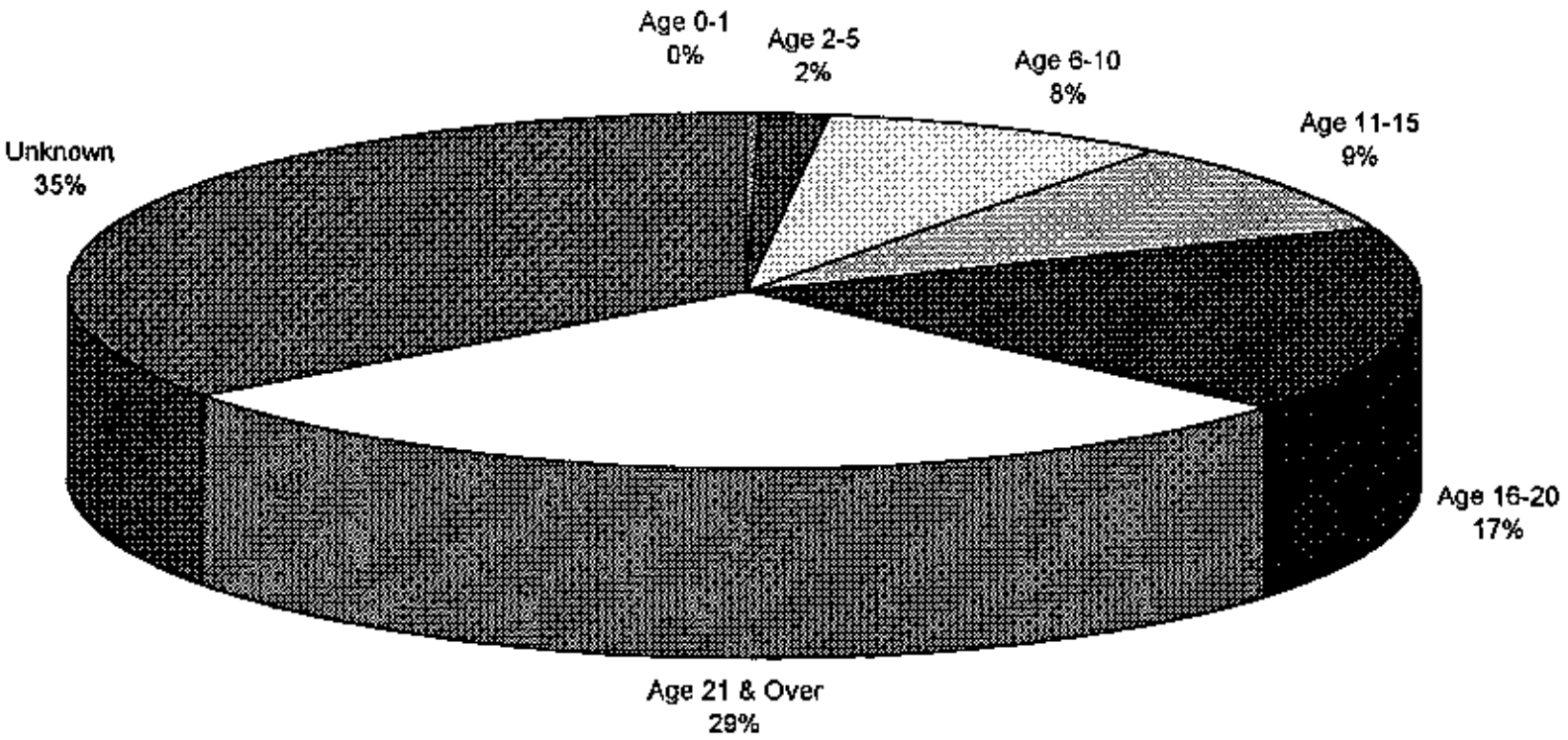

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FIGURE 18: PIPING DESIGN

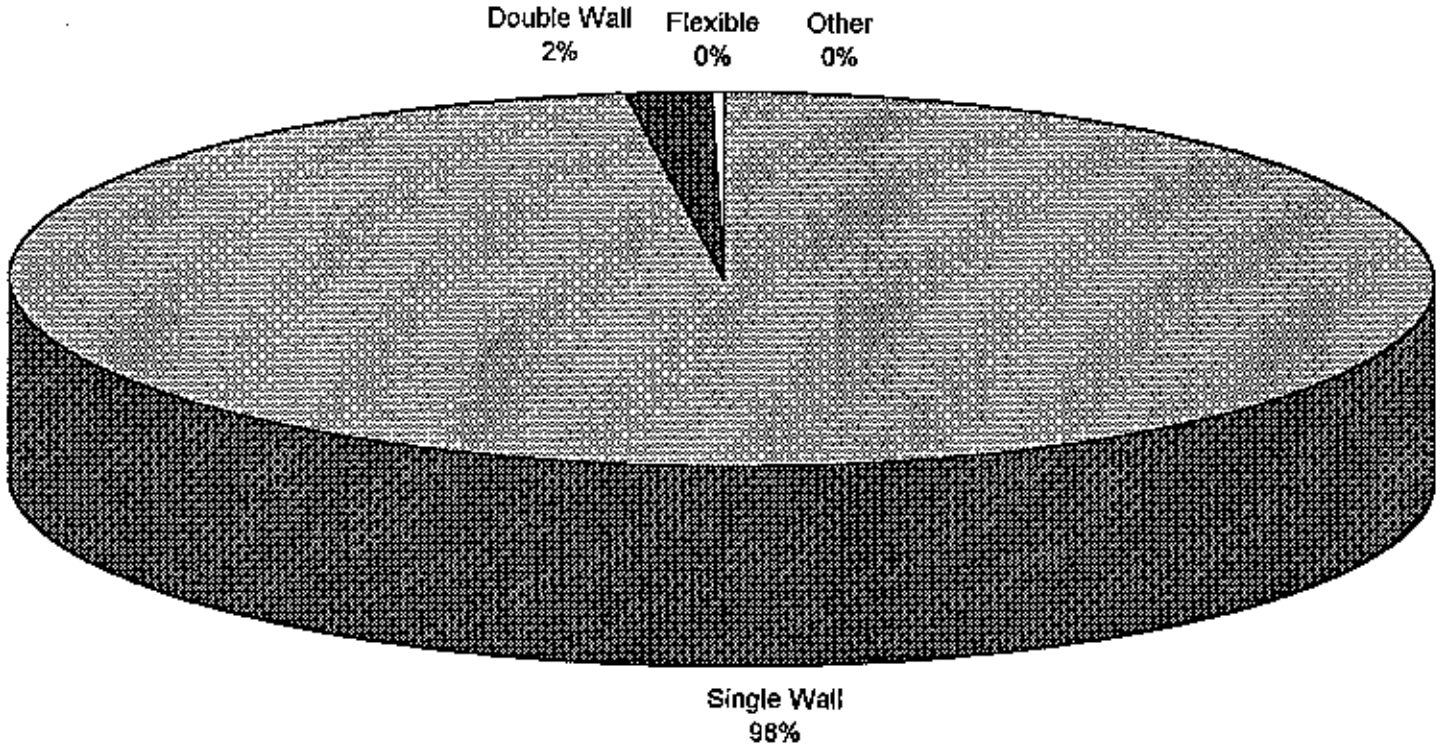

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FIGURE 19: PIPING CONSTRUCTION

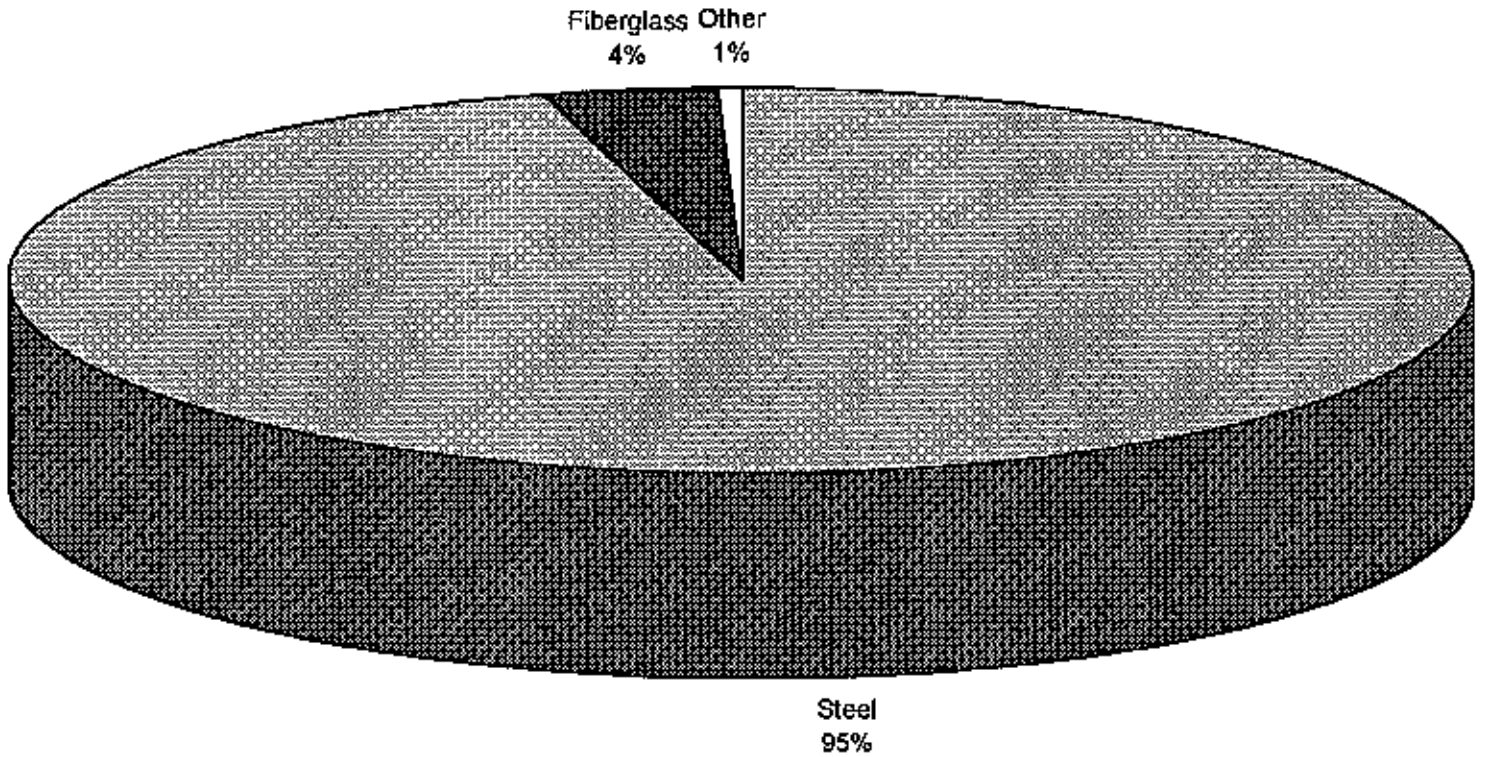

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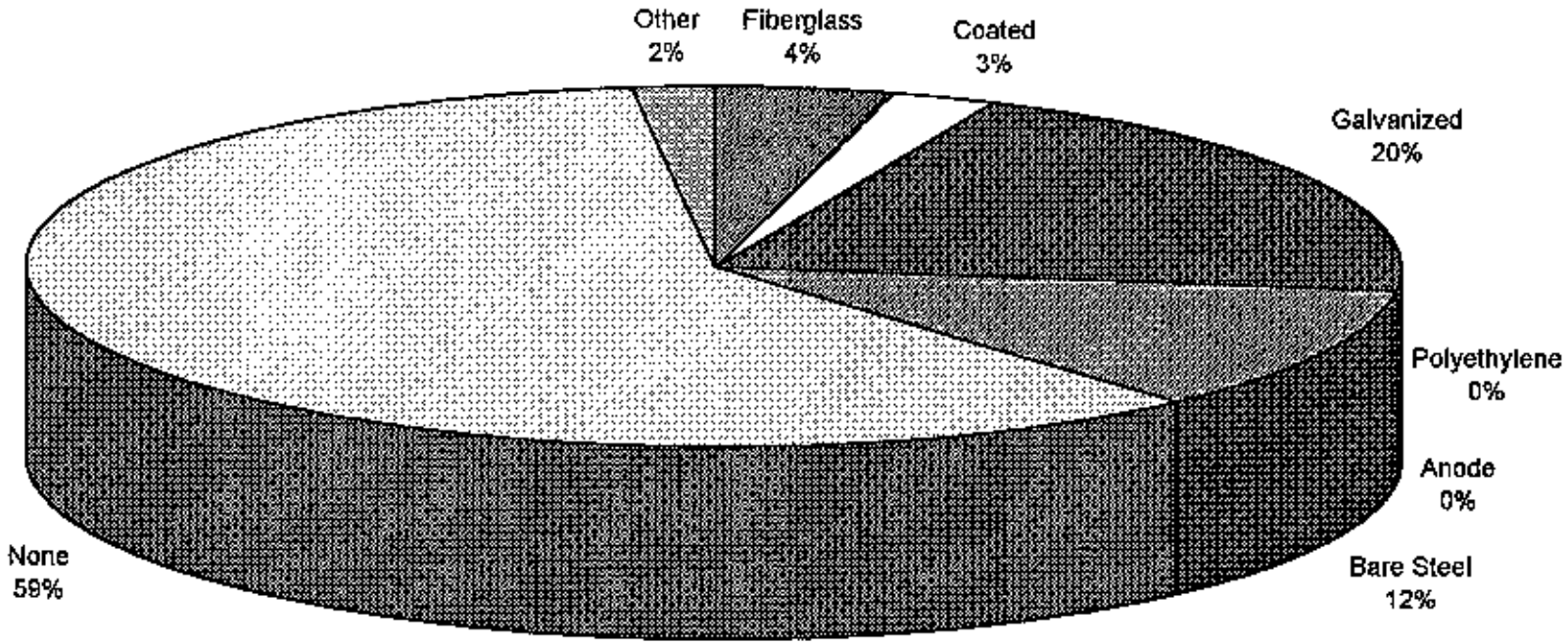
FIGURE 20: CORROSION PROTECTION - PIPING



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